# Patent classifications for aeronautics and aviation, 1880-1918

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Views presented by the author do not represent views of the government agency

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# Research questions

- How do national patent offices classify technologies in the 19th century?
- How do they incorporate airplanes and aviation?

Patent offices confront macroinventions early

We seeking historical/narrative answers, *and* statistically measured answers based on patents

# Who classifies, and why

Classifications are assigned by the patent offices.

- To organize their work assignments
- To enable searches by patent office staff for “prior art”
- And by external patent applicants and agents

- Sometimes required by law; classification itself may be in law

- Indirectly, to reduce or ease legal cases
- Not mainly for research beyond production needs

# Early example: U.S. classification of 1836

| Class | Name |
|---|---|
| 1 | Agriculture |
| 2 | Metallurgy |
| 3 | Fibrous and Textiles substances |
| 4 | Chemical Processes |
| 5 | Calorifics |
| 6 | Steam and Gas Engines |
| 7 | Navigation and Maritime Implements |
| 8 | Mathematical, Philosophical, and Optical Instruments |
| 9 | Civil Engineering and Architecture |
| 10 | Land Conveyances |
| 11 | Hydraulics and Pneumatics |
| 12 | Lever, Screw, and Mechanical Power |
| 13 | Grinding Mills and Mill-Gearing |
| 14 | Lumber |
| 15 | Stone and Clay manufactures |
| 16 | Leather |
| 17 | Household Furniture |
| 18 | Arts |
| 19 | Fire Arms and Implements of War |
| 20 | Surgical and Medical Instruments |
| 21 | Wearing Apparel |
| 22 | Miscellaneous |
| 23 | Extensions, Reissues, Improvements, etc. |

- 23 categories
- Note overlap: an industry category (agriculture) and tech categories for engines, fuel, chemical processes.
- Later systems organize less by industry and more by narrow technical “function”
- Later systems avoid administrative classes like Class 23
- Aeronautics descends from class 11

# Alternative principles of classification

- Industry of use
- Product or effect -- output, e.g. a chemical, or a phone call)
- Function – narrow and proximate, e.g. grinding, cooling
- Structure -- chemical, alloy

- Combinations of the above
- Focused on key claims in the patent

- Industry was used in 19th century, and less now
  - As tools, techs, and methods are reused across application areas

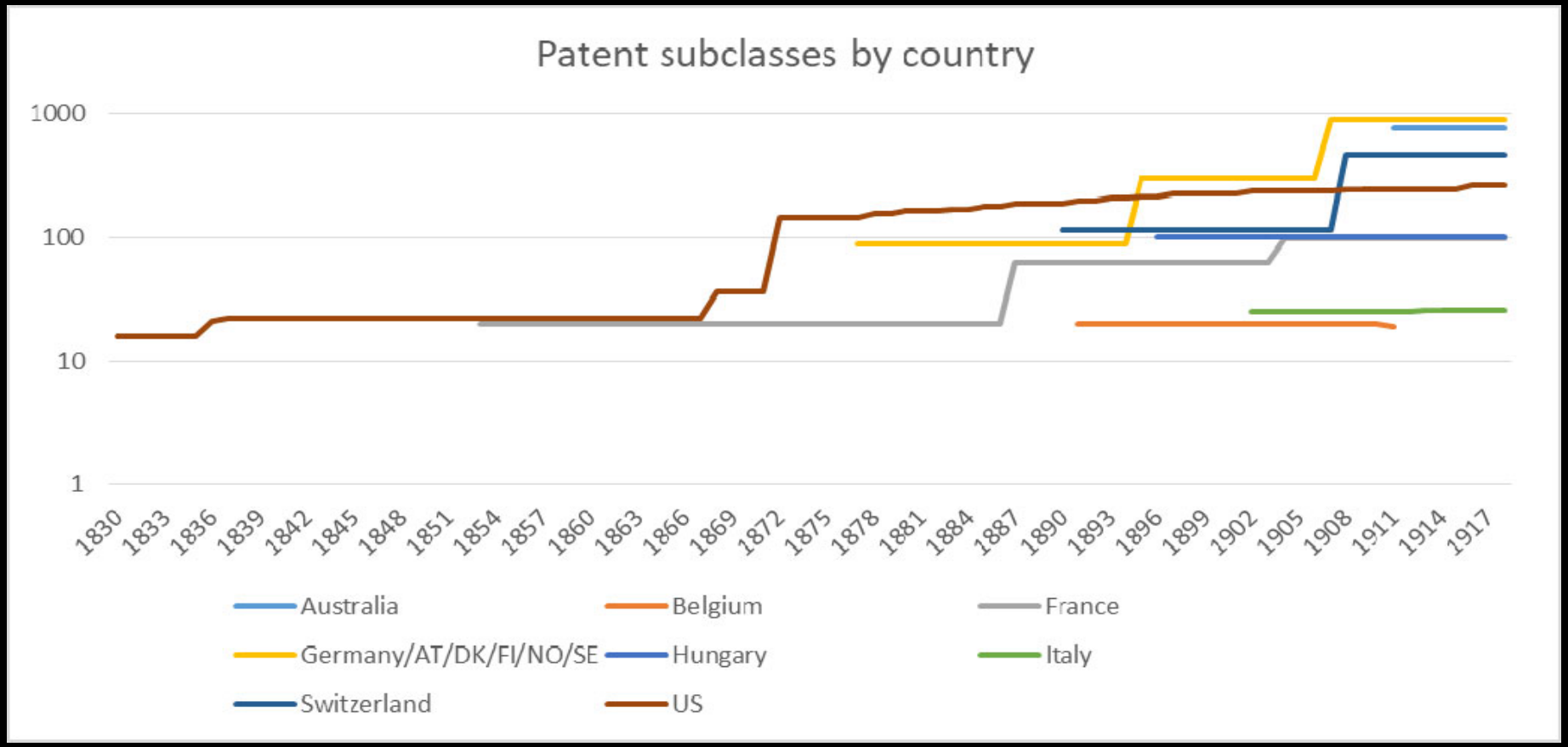
- Multiple labeling, or cross-referencing, subject matter indexes
  - Won't look at those here

Source: USPTO Handbook of Classification, 2005

# Early patent classifications

Our information is imperfect on both dates and contents.

- US and Belgium: 1830 or so – single exclusive categories
- UK: 1850s, Woodcroft's -- subject-matter index, multiple classification
- France 1853 system
- Germany 1877-78
- Austria, Norway, Denmark, Finland, Sweden adopt Germany's system
  - Austria: 1890s, in law (possibly earlier system in Austria-Hungary)
  - Hungary, 1896-
- Swiss systems 1888, 1890 -- details thanks to Nicolas Chachereau
- Italy, 25 categories starting 1902
- Australia, around the same time -- we have 1906 documentation
- Netherlands 1912




- Counts (estimates) of mutually exclusive categories a patent might go into.
  - Meaning: the narrowest subclasses, not umbrella classes

- US, German, and Hungarian categories are undercounted here starting around 1900
- Subclasses appear; in this project we try to get counts and timing.
- We need lists to be sure; subclasses can appear quietly.

# Normal classification evolution

- There are more categories over time generally
  - A function of patent numbers and/or complexity
- It's relatively easy to split an existing category
  - Adds detail; doesn't break earlier system
- It's difficult to reorganize deeply
  - It affects searching practices, and requires consensus
  - Often calls for a reclassification o earlier patents

# French patent classifications, 1853
20 categories
agriculture, metallurgy, firearms are categories.

| Category # | Title |
|---|---|
| 1 | Agriculture |
| 2 | Hydraulique, sondage |
| 3 | Machines a vapeur |
| 4 | Machines appliquees aux matieres textiles, tissus |
| 5 | Machines et appareils divers, outils |
| 6 | Navigation |
| 7 | Construction, batiments |
| 8 | Metallurgie |
| 9 | Quincaillerie, serrurerie, coutellerie |
| 10 | Carrosserie, charronnage, sellerie, bourrellerie, corderie, brosserie |
| 11 | Arquebuserie |
| 12 | Instruments de precision |
| 13 | Substances minerales, ceramique |
| 14 | Produits chimique, aliments, conservation des substances alimentaires, cosmetiques |
| 15 | Appareils d'eclairage et de chauffage, combustibles |
| 16 | Habillement, chapellerie, ganterie, chaussures |
| 17 | Beaux-arts, instruments de musique |
| 18 | Papeterie |
| 19 | Cuirs et peaux (1853-1896) |
| | Chirurgie, medecine, hygiene (1896-1904) |
| 20 | Articles divers |

# French patent classifications, 1904
99 categories, often re-dividing those 20

| Main category | Subcategories | In English |
|---|---|---|
| I. Agriculture | I.1 Matériel et machines agricoles | I.1 Agricultural machinery and equipment |
| | I.2 Engrais et amendements | I.2 Fertilizers and soil improvers |
| | I.3 Travaux d'exploitation, génie rural | I.3 Farming operations, rural engineering |
| | I.4 Elevage et destruction des animaux, chasse, peche | I.4 Livestock breeding and destruction, hunting, fishing |
| II. Alimentation | II.1 Meunerie et industries s'y rattachant | II.1 Milling and related industries |
| | II.2 Boulangerie, patisserie | II.2 Bakery, pastry |
| | II.3 Sucres, confiserie, chocolaterie | II.3 Sugar, confectionery, chocolate |
| | II.4 Produits et conserves alimentaires | II.4 Food products and canned foods |
| | II.5 Boissons, vins, vinaigre, tonnellerie | II.5 Beverages, wines, vinegar, cooperage |
| III. Chemins de fer et tramways (Railways and trams) | III.1 Voie | III.1 Tracks |
| | III.2 Locomotives, traction mécanique sur rail | III.2 Locomotives, mechanical traction on rails |
| | III.3 Traction électrique sur rail | III.3 Electric track traction |
| | III.4 Voitures et accessoires | III.4 Cars and accessories |
| | III.5 Appareils divers se rapportant a l'exploitation | III.5 Operations |

Subdividing was common.
The larger class is often not used any more.

Categories are also changed/renamed or created.

# French patent specifications show the class

RÉPUBLIQUE FRANÇAISE.

OFFICE NATIONAL DE LA PROPRIÉTÉ INDUSTRIELLE.

# BREVET D'INVENTION.

**VI. — Marine et navigation.**
4. — Aérostation.

N° 342.188

## Perfectionnements aux machines aéronautiques.

MM. Orville WRIGHT et Wilbur WRIGHT résidant aux États-Unis d'Amérique.

**Demandé le 22 mars 1904.**
Délivré le 1er juillet 1904. — Publié le 1er septembre 1904.
(Demande de brevet déposée aux États-Unis d'Amérique le 23 mars 1903. — Déclaration du déposant.)

Cette invention est relative à des perfectionnements aux machines aéronautiques dans

nant à l'ensemble de la machine une grande rigidité et solidité transversales. Les articula-

# Similarly German patents show the class

Otto Lilienthal MUSEUM

KAISERLICHES PATENTAMT.

# PATENTSCHRIFT

— № 84417 —

KLASSE 77: SPORT.

## OTTO LILIENTHAL IN BERLIN.

**Flugapparat.**

Zusatz zum Patente № 77916 vom 3. September 1893.

**Patentirt im Deutschen Reiche vom 29. Mai 1895 ab.**

**Längste Dauer: 2. September 1908.**

Bei dem unter Nr. 77916 geschützten Flugapparat hat sich der Uebelstand gezeigt, dafs, wenn der Apparat die Luft unter sehr spitzem Winkel durchschneidet, die Vorderkante infolge der gewölbten Flächenform Druck von oben erhalten kann. Dadurch wird ein stabiles Durchsegeln der Luft gefährdet, und der Apparat aus seiner Flugrichtung gedrängt.

Um dieses zu vermeiden, wird die vordere Flächenpartie derart beweglich gemacht, dafs dieselbe um die Vorderkante drehbar sich nach unten richten kann. Das in Fig. 1 schraffirte Flächenstück kann sich um die Achse *a b* nach unten, etwa bis in die Lage *c d* (Fig. 2) herabsenken, durch einen Luftdruck von unten aber wieder bis in die Lage *c e* erheben. Durch federnde Organe *f f* hat das schraffirte Flächenstück das Bestreben, die gesenkte Lage *c d* einzunehmen, und zwar ist der normale, auf diese bewegliche Fläche entfallende Luftdruck gerade ausreichend, um die Federn *f f* so weit zu spannen, dafs das vordere Flächenstück in die gehobene Lage *c e* gelangt und dadurch ein Theil der ganzen geschlossenen Flügelfläche wird. Hierdurch ergiebt sich die Wirkungsweise insofern, als bei einer Luftdruckverminderung unter der schraffirten Fläche *c e* die federnden Organe die Fläche selbst nach unten drücken, wodurch der verminderte Luftdruck sich wieder ergänzt und aufrichtend auf den ganzen Apparat wirkt, bis die zu einem stabilen Fluge des Apparates erforderliche Lage wieder erreicht ist.

PATENT-ANSPRUCH:

Eine Ausführungsform des durch Patent Nr. 77916 geschützten Flugapparates, bei welcher der vordere Theil der Flügelfläche um die Vorderkante *(a b)* nach unten drehbar ist und durch federnde Organe *f f* nach unten gedrückt wird, so dafs er sich beim Nachlassen des von unten wirkenden Luftdruckes nach unten dreht und dadurch ein den Apparat aufrichtendes Moment erzeugt.

Hierzu 1 Blatt Zeichnungen.

Otto Lilienthal MUSEUM

OTTO LILIENTHAL IN BERLIN.

**Flugapparat.**

*Fig. 1.*

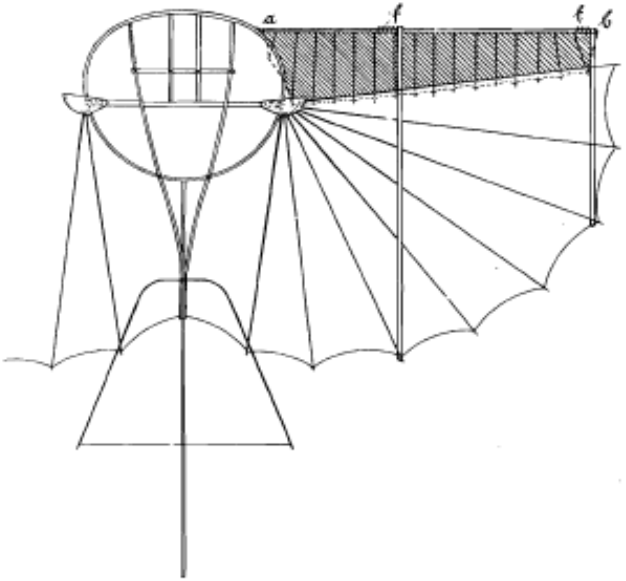



*Fig. 2.*


Zu der Patentschrift

№ 84417.

PHOTOGR. DRUCK DER REICHSDRUCKEREI.

# German system 1877-1900

- An examination system, with high standards
- Had 89 categories, alphabetically listed

- Two major expansions of detail
  - ~1900: from “Klasse 77” to Klasse 77d, 77h, etc
  - ~1907: Adding another level, to “77h group 3"
  - Not reorganized

- The 1878 system is adopted by Austria, Denmark, Finland, Norway, Sweden
  - Almost identically
  - The expansions of detail are not adopted in the same way
  - Similarities may be in law, and variations in office practice

# Classification activity expanded

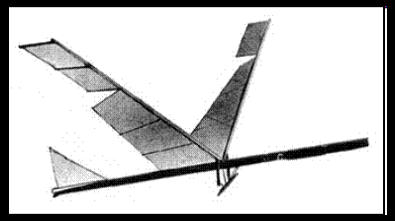
- US Patent Office categorized for its own purposes before 1830
- Then was mandated to by Congress, 1836
- Patents numbers grew greatly 1850-70

- 1898: new Classification Division in the Patent Office
  - developing the classification itself; examiners classify actual patents
- 1900-1912, long lasting US classification developed
  - Based on proximate function when possible
  - Industry, structure, effect, or product when needed.

- Classification Division had staff of 36 in 1923

# Aerial navigation

- Growing steadily from 1860s
- Sharp growth starting 1906
- Diverse, surprising ideas/themes:
  - Balloons/dirigibles
  - Flapping wings
  - Helicopters, etc
  - Kites, gliders → aeroplanes



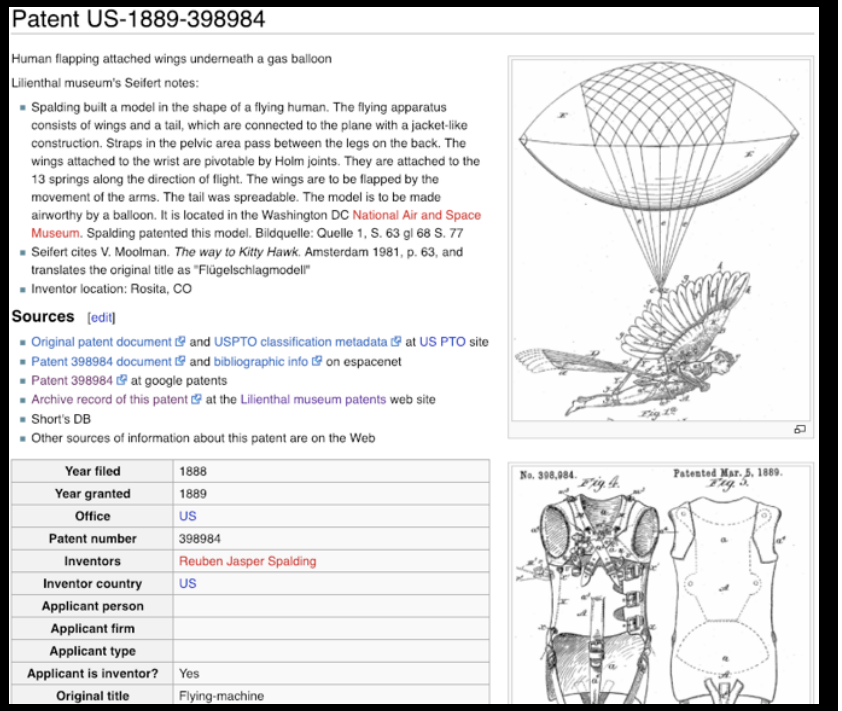
# Aero patent data

- We have data on 15,000 aero patents up to 1920 from many sources
- Continuing search for them by classification, inventor name, key words
- We build associated records of inventors (biographies), publications, firms, clubs exhibitions

- And patent subclasses of many systems

Historical challenges:

- silent or informal changes
- numerous or confusing categories
- Later reclassification; hard to see how ORIGINALLY classified



Patent US-1889-398984

Human flapping attached wings underneath a gas balloon

Lilienthal museum's Seifert notes:

- Spalding built a model in the shape of a flying human. The flying apparatus consists of wings and a tail, which are connected to the plane with a jacket-like construction. Straps in the pelvic area pass between the legs on the back. The wings attached to the wrist are pivotable by Holm joints. They are attached to the 13 springs along the direction of flight. The wings are to be flapped by the movement of the arms. The tail was spreadable. The model is to be made airworthy by a balloon. It is located in the Washington DC National Air and Space Museum. Spalding patented this model. Bildquelle: Quelle 1, S. 63 gl 68 S. 77
- Seifert cites V. Moolman. *The way to Kitty Hawk*. Amsterdam 1981, p. 63, and translates the original title as "Flügelschlagmodell"
- Inventor location: Rosita, CO

**Sources** [edit]

- Original patent document and USPTO classification metadata at US PTO site
- Patent 398984 document and bibliographic info on espacenet
- Patent 398984 at google patents
- Archive record of this patent at the Lilienthal museum patents web site
- Short's DB
- Other sources of information about this patent are on the Web

| | |
|---|---|
| Year filed | 1888 |
| Year granted | 1889 |
| Office | US |
| Patent number | 398984 |
| Inventors | Reuben Jasper Spalding |
| Inventor country | US |
| Applicant person | |
| Applicant firm | |
| Applicant type | |
| Applicant is inventor? | Yes |
| Original title | Flying-machine |

# Aero category has various starting locations

- French category 6, for **marine navigation** adds ballooning (aerostation), then aerial navigation and flying machines
- US puts aero inventions into class 98, **Pneumatics**
- German 77 for **Sport** has kites, then gliders, then airplanes
- Hungarian V for "**Railways and machinery**" gets aircraft too, in subclass V/h
- British renamed category 4 is for **Aeronautics** starting in 1884.

- These aviation category generally included frame, wings, propulsion, controls, etc.

➔ Aircraft stuff kept together in a category

➔ Control systems for locomotives, boats, and aircraft were not kept together

- These categories last!

# Patent families can compare classifications

An invention could be patented in two countries

Such “foreign filings” give data coded in two systems.

We find these in the data mostly one-by-one, based on

(a) Patents which say they are foreign filings, or

(b) Patent specifications with the same diagrams

Patentees only sometimes mention the earlier filing. Possible reasons:

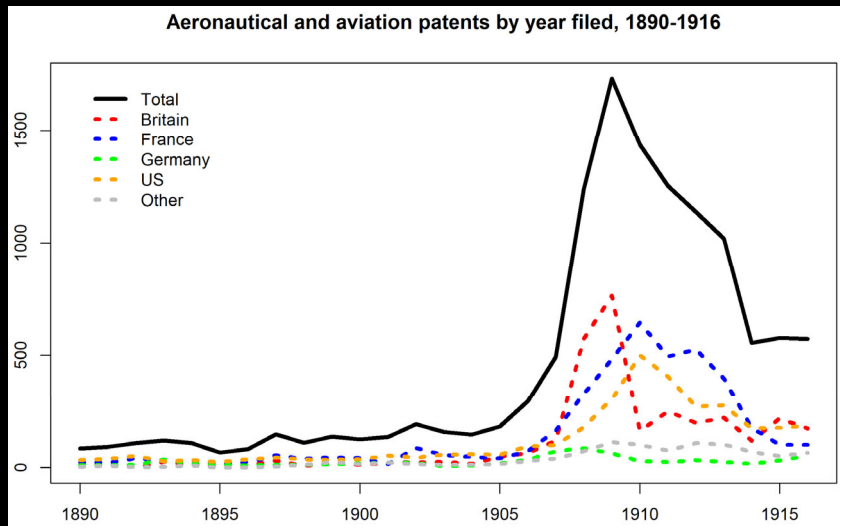
(1) it hasn’t been approved in the first country yet

(2) the inventor does not benefit from linking them

Foreign filings were common in the boom period.

We have more than 500 foreign filings in our data

And we continue to find more.



# A potential metric of difference

Patent families show the same invention classified in two systems.

Crosswalks like those below can compare.

Categories may be divided based on different concepts

Proposed statistic: the predictive accuracy going in each direction, from 0 to 1.

Near 1 ←→ high accuracy ←→the crosswalk is informative

→ the systems have the same classification substantively.

Below, hypothetical countries A and B have similar systems; A and C do not

| | | Country B's classification | | |
|---|---|---|---|---|
| | | wood propellers | metal propellers | other |
| Country A's classification | aerial propellers | 9 | 0 | 1 |
| | marine propeller | 1 | 9 | 0 |

90% predictable; almost the same

| | | Country C's classification | |
|---|---|---|---|
| | | 2 blades | More than 2 blades |
| Country A's classification | marine propeller | 3 | 1 |
| | aerial propellers | 3 | 1 |

50% predictable ; substantively different

# How well does subclass predict across countries?

Can compare across FR, DE/AT/DK, BE, & HU patents

➔ At least 75% of the time, knowing an aero patent's subclass in one country predicts where it will show up in the others

➔ They had SIMILAR systems for early aero

In most countries, before 1900, airplanes, balloons, and helicopters were together in one class. (AT 77, AU 90.5, BE K, CH 115 then 129, DE 77, FR 6.3 then 6.4, GB 4, HU V/h, IT 8, US 98)

Exceptions: Safety; piloting (AT 61); Wind tunnels (FR 12.3); Motors (FR 5.8)

Invention that could work in the water: marine propellers (FR 6.3)

➢ More differences appear with more detail; in later years, more detailed subclasses are not matched in other countries (DE 77h, 77h.2 etc, AT 77d)

# Conclusion

The classification systems vary in stability and detail, and in their intended usage somewhat.

- For examiners or for public ; common law vs civil law designs ; exclusive categories vs subject matter indexes
- Numbers of subclasses grow sharply around 1900
  - more classification activity

The systems start aeronautics in different places

- Starts in existing category, more is grafted on, then it splits
- Boundaries not quickly reorganized in response to macroinvention

Can test whether different classification systems are fundamentally different